2. The spectrum is different in different parts of the nebula.

3. The spectrum bears a striking resemblance to that of the planetary nebulæ and bright line stars.

4. The suggestion, therefore, that these are bodies which must be closely associated in any valid scheme of classification, is confirmed.

5. Many of the lines which appear bright in the spectrum of the nebula appear dark in the spectra of stars of Groups II and III; and in the earlier stars of Group IV, and a gradual change from bright to dark lines has been found.

6. The view, therefore, that bright line stars occupy an intermediate position between nebulæ and stars of Groups II and III is greatly strengthened by these researches.

XIV. "On the Absorption Spectra of Dilute Solutions." By Thos. Ewan, B.Sc., Ph.D., 1851 Exhibition Scholar in Chemistry in the Owens College. Communicated by Professor H. Dixon, F.R.S. Received April 7, 1894.

(Abstract.)

The measurements recorded in the paper were made in the hope of obtaining some information as to the molecular condition of salts in dilute solution.

In order to obtain exact quantitative results it is necessary to measure the extinction coefficients of the solutions. For this purpose a new spectrophotometer was devised, by means of which it was possible to work with very dilute solutions. In this instrument, by the advice of Professor A. Schuster, F.R.S., a Lummer and Brodhun photometric prism was used, and the photometric measurements were made by means of Abney's rotating sector.

The absorption spectra of solutions of cupric sulphate, chloride bromide and nitrate, containing generally 0·003 to 0·004 gr. mol. per litre, were measured and found to be, within the limits of experimental error, identical. The solutions of cupric acetate absorb, for the same amount of copper, much more light than those of the other salts used. The difference tends to disappear as the solutions become more dilute, and it is increased by the addition of acetic acid. These facts point to the conclusion that the difference is due to the incomplete electrolytic dissociation of the salt, and to the undissociated part having an absorption spectrum differing from that of the dissociated part.

Dilute solutions of the potassium and ammonium salts of α-dinitrophenol (1 · 2 · 4) were found to possess very nearly the same absorp-

tion spectrum. The mean of the numbers obtained for these two salts was regarded as the absorption spectrum of the ion $C_6H_3(NO_2)_2O$. The solution of dinitrophenol in hydrochloric acid (containing the undissociated molecule $C_6H_3(NO_2)_2OH$) absorbs very little light; it is almost colourless. The extinction coefficients of dinitrophenol, and of its coloured ion, being thus known, it was possible to calculate from measurement of the extinction coefficients of a series of solutions of dinitrophenol in pure water, its degree of dissociation in these solutions. The numbers thus obtained were in very satisfactory agreement with the numbers calculated from the electrical conductivity of the solutions.

As an example of the hydrolytic decomposition of a salt in aqueous solution, to the study of which the spectro-photometric method can be advantageously applied, ferric chloride was taken.

By filtering dilute solutions of ferric chloride through a porous cell all the colloid ferric hydroxide formed can be removed; and analyses of the solutions before and after filtration showed that the hydroxide formed in solutions containing less than 0·005 gram molecule of $FeCl_3$ per litre contains no chlorine. The decomposition which occurs in these solutions may thus be most simply expressed by the equation $FeCl_3+3H_2O \rightleftharpoons Fe(OH)_3+3HCl$.

The photometric determinations of the quantity of ferric hydroxide formed in these solutions agreed fairly well with the results of the filtration experiments, though, owing to the difficulty in obtaining the solutions of ferric chloride perfectly clear, they were not so satisfactory as could be desired.

The quantities of ferric hydroxide formed were not in agreement with the law of Guldberg and Waage, but agreed much better with the modified form of the law due to Arrhenius, in which the electrolytic dissociation of the different substances is taken into account.

It was observed that solutions of ferric hydroxide obtained by dissolving ferric chloride in a very large quantity of water, had a different absorption spectrum from that of solutions of ferric hydroxide obtained by dialysis. It is suggested that an explanation of this fact may be found in the differences in the complexity of the molecular aggregates existing in the different solutions.

Finally, solutions of ferric chloride, to which small quantities of hydrochloric acid had been added, possess such comparatively small power of absorbing light that they cannot be regarded as containing any colloid hydroxide of iron.